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10/574,571	04/28/2006	Atsushi Sano	127570	5708
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EXAMINER NIKMANESH, SEAHVOSH J				
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**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

## Office Action Summary

**Application No.**

10/574,571

**Applicant(s)**

SANO ET AL.

**Examiner**

SEAHVOSH J. NIKMANESH

**Art Unit**

2812

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 16 July 2008.  
2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.  
3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-21 is/are pending in the application.  
4a) Of the above claim(s) 20-21 is/are withdrawn from consideration.  
5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.  
6) ☒ Claim(s) 1-16 is/are rejected.  
7) ☒ Claim(s) 17-19 is/are objected to.  
8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.  
10) ☒ The drawing(s) filed on 04 April 2006 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).  
11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☒ All b) ☐ Some \* c) ☐ None of:  
1. ☒ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)  
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)  
3) ☒ Information Disclosure Statement(s) (PTO-850)  
Paper No(s)/Mail Date 4/4/2006, 5/5/2008, 6/3/2008, and 7/16/2008  
4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date: \_\_\_\_\_  
5) ☐ Notice of Informal Patent Application  
6) ☐ Other: \_\_\_\_\_



**DETAILED ACTION**

1. This is in response to the information disclosure statement filed 7/16/2008.

***Election/Restrictions***

2. Applicant's election without traverse of Group I, claims 1-19 in the reply filed on 6/13/2008 is acknowledged.
3. Claims 20 and 21 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim. Election was made **without** traverse in the reply filed on 6/13/2008.

***Priority***

4. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

***Information Disclosure Statement***

5. The information disclosure statements filed 4/4/2006, 5/5/2008, 6/3/2008, and 7/16/2008.

***Claim Rejections - 35 USC § 102***

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

7. Claims 1-5 and 7-15 rejected under 35 U.S.C. 102(b) as being anticipated by Kher et al., US PGPub 2003/0232501 A1.

a. **Regarding claim 1**, Kher et al. shows a manufacturing method of a semiconductor device comprising the steps of:

forming a film containing a metal atom and a silicon atom on a substrate [0022]; and

performing a nitriding process [0044] for the film, wherein the film is formed by changing a silicon concentration in at least two stages in the step of forming the film (Figs. 2A-C and 9B; [0024]).

b. **Regarding claim 2**, Kher et al. shows that the film has different silicon concentration in a depth direction is formed in the step of forming the film (Figs. 2C and 9B; [0024]; i.e. layers formed of controllable proportions).

c. **Regarding claim 3**, Kher et al. shows that the film is composed of two or more layers having different silicon concentration respectively is formed in the step of forming the film (Figs. 2C and 9B; [0024]; i.e. layers formed of controllable proportions).

d. **Regarding claim 4**, Kher et al. shows the step of forming the film, so that the surface side of the film has a larger silicon concentration than that of a substrate side (Fig. 9B; [0024]; i.e. the process is controllable).

e. **Regarding claim 5**, Kher et al. shows the film is formed in the step of forming the film, so that a surface side of the film becomes silicon-rich, and a

substrate side of the film becomes metal-rich (Fig. 9B; [0024]; i.e. the process is controllable).

f. **Regarding claim 7**, Kher et al. shows that the metal atom is hafnium and the film is a hafnium silicate film (Fig. 2C and 9B; [0024]).

g. **Regarding claim 8**, Kher et al. shows the step of performing the nitriding process is conducted in the same reaction chamber as the reaction chamber where the step of forming the film is conducted ([0058]; Fig. 6).

h. **Regarding claim 9**, Kher et al shows a manufacturing method of a semiconductor device, comprising the steps of:

forming a film containing a metal atom and a silicon atom on a substrate (Figs. 2C and 9B; i.e. Hf silicate); and

introducing nitrogen into the film ([0044] and [0058]), wherein a nitrogen concentration introduced into the film in the step of introducing nitrogen is controlled by a silicon concentration in the film formed in the step of forming the film [0023]-[0026] and [0059]; sufficient nitrogen is needed to improve the hydroxylation effects and reduce radical bond points)..

i. **Regarding claim 10**, Kher et al. shows a manufacturing method of a semiconductor device comprising the steps of:

carrying a substrate into a reaction chamber [0052];

processing the substrate by feeding a first source gas obtained by vaporizing a first source which is prepared by mixing plural kinds of liquid

sources, and a second source gas obtained by vaporizing a second source which is prepared by mixing plural kinds of liquid sources at a mixing ratio different from that of the first source, or composed of one kind of liquid source ([0023]-[0026], [0044], and [0059]; Figs. 2C, 6, and 9B);  
and

carrying the substrate after processing out of the reaction chamber [0052].

- j. **Regarding claim 11**, Kher et al. shows that the supply flow rate of the first source and/or second source is changed respectively in the step of processing the substrate [0059].
- k. **Regarding claim 12**, Kher et al. shows that the first source gas and the second source gas are simultaneously fed to the substrate in the step of processing a substrate [0059].
- l. **Regarding claim 13**, Kher et al. shows that the first source gas and the second source gas are alternately fed to the substrate in the step of processing the substrate [0059].
- m. **Regarding claim 14**, Kher et al. shows that feeding of the first source gas and the second source gas, and feeding of a third source gas different from the first and second source gases are alternately performed by at least more than once in the step of processing a substrate [0059].
- n. **Regarding claim 15**, Kher et al. shows that the feeding of the first source gas and feeding of the second source gas are alternately performed by at least more than once, with feeding of a third source gas different from the first

and second source gases intervened between the feeding of the first source gas and the feeding of the second source gas [0059].

8. Claims 1-3, 5, and 7-8 are rejected under 35 U.S.C. 102(b) as being anticipated by Harada, US PGPub 2002/0195643 A1.

a. **Regarding claim 1**, Harada shows a manufacturing method of a semiconductor device comprising the steps of:

forming a film (25) containing a metal atom and a silicon atom on a substrate [0111]; and

performing a nitriding process for the film [0116], wherein the film is formed by changing a silicon concentration in at least two stages in the step of forming the film ([0114]-[0116]; Figs. 7A-9D).

b. **Regarding claim 2**, Harada shows that the film (25; Fig. 8C) having different silicon concentrations in a depth direction is formed in the step of forming the film ([0109], [0114]-[0116]; i.e. each of the portions the ultimately form the dielectric film, 25, has a varied amount of silicon due to the densification and diffusion of the silicon throughout the film).

c. **Regarding claim 3**, Harada shows that the film (25; Fig. 8C) is composed of two or more layers (21/22/23) having different silicon concentration respectively is formed in the step of forming the film ([0109], [0114]-[0116]; i.e. each of the portions the ultimately form the dielectric film, 25, has a varied

amount of silicon due to the densification, and diffusion of the silicon throughout the film).

e. **Regarding claim 5**, Harada shows the film is formed in the step of forming the film, so that a surface side of the film becomes silicon-rich, and a substrate side of the film becomes metal-rich ([0114]; i.e. the surface layer becomes a silicon containing Hf portion, while the substrate side becomes a Hf-containing SiON portion).

f. **Regarding claim 7**, Harada shows that the metal atom is hafnium and the film is a hafnium silicate film ([0110], lines 1-2).

g. **Regarding claim 8**, Harada shows the step of performing the nitriding process is conducted in the same reaction chamber as the reaction chamber where the step of forming the film is conducted ([0109]-[0110] and [0116]).

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

9. Claims 1-3 and 6-16 are rejected under 35 U.S.C. 102(e) as being anticipated by Vaartstra, US PGPub 2004/0040501 A1.

a. **Regarding claim 1**, Vaartstra shows a manufacturing method of a semiconductor device comprising the steps of:

forming a film containing a metal atom [0037] and a silicon atom [0034] on a substrate; and

performing a nitriding process ([0046] and [0062]) for the film, wherein the film is formed by changing a silicon concentration in at least two stages in the step of forming the film (Fig. 1; [0054] and [0044]).

b. **Regarding claim 2**, Vaartstra shows that the film has different silicon concentration in a depth direction is formed in the step of forming the film ([0054] and [0056]).

c. **Regarding claim 3**, Vaartstra shows that the film is composed of two or more layers having different silicon concentration respectively is formed in the step of forming the film [0056].

d. **Regarding claim 6**, Vaartstra shows that the film is formed by using a first source containing a metal atom and a second source containing a silicon atom,

intermittently feeding each source to the substrate, and changing a supply flow rate or supply time of each source respectively [0011], [0052], [0054], and [0058]).

e. **Regarding claim 7**, Vaartstra shows that the metal atom is hafnium and the film is a hafnium silicate film [0027].

f. **Regarding claim 8**, Vaartstra shows the step of performing the nitriding process is conducted in the same reaction chamber as the reaction chamber where the step of forming the film is conducted (Fig. 2; [0062]).

g. **Regarding claim 9**, Vaartstra shows a manufacturing method of a semiconductor device, comprising the steps of:

forming a film containing a metal atom [0037] and a silicon atom [0034] on a substrate; and

introducing nitrogen into the film [0046] and [0062], wherein a nitrogen concentration introduced into the film in the step of introducing nitrogen is controlled by a silicon concentration in the film formed in the step of forming the film (The nitrogen concentration is dependent upon the amount of open bond sites or holes created by diffusion of species) .

h. **Regarding claim 10**, Vaartstra shows a manufacturing method of a semiconductor device comprising the steps of:

carrying a substrate into a reaction chamber (Fig.2);

processing the substrate by feeding a first source gas obtained by vaporizing a first source which is prepared by mixing plural kinds of liquid

sources, and a second source gas obtained by vaporizing a second source which is prepared by mixing plural kinds of liquid sources at a mixing ratio different from that of the first source, or composed of one kind of liquid source [0044]-[0048] and [0054]; and

carrying the substrate after processing out of the reaction chamber (Fig. 2).

- i. **Regarding claim 11**, Vaartstra shows that the supply flow rate of the first source and/or second source is changed respectively in the step of processing the substrate ([0048]-[0051]).
- j. **Regarding claim 12**, Vaartstra shows that the first source gas and the second source gas are simultaneously fed to the substrate in the step of processing a substrate ([0047]-[0048]).
- k. **Regarding claim 13**, Vaartstra shows that the first source gas and the second source gas are alternately fed to the substrate in the step of processing the substrate ([0052]-[0058]).
- l. **Regarding claim 14**, Vaartstra shows that feeding of the first source gas and the second source gas, and feeding of a third source gas different from the first and second source gases are alternately performed by at least more than once in the step of processing a substrate [0054].
- m. **Regarding claim 15**, Vaartstra shows that the feeding of the first source gas and feeding of the second source gas are alternately performed by at least more than once, with feeding of a third source gas different from the first

and second source gases intervened between the feeding of the first source gas and the feeding of the second source gas [0054].

o. **Regarding claim 16**, Vaartstra shows that the plural kinds of liquid sources [0040] constituting the first source are a Hf liquid source [0037] and a Si liquid source [0035], the one kind of liquid source constituting the second source is either of the Hf liquid source [0037] or the Si liquid source [0034], and a process means to form a Hf silicate film ([0044] and [0051]; i.e. deposition chamber Fig. 2).

***Allowable Subject Matter***

10. Claims 17-19 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

11. The following is a statement of reasons for the indication of allowable subject matter:

a. **Regarding claim 17**, the prior art of the record does not anticipate or makes obvious the applicants method of using a mixing ratio for silicon and hafnium in the first source (Si liquid source/Hf liquid source) to be from 100-1000.

b. **Regarding claim 18**, the prior art of the record does not anticipate or makes obvious the applicants method of using a composition ratio  $Hf/(Hf + Si)$  of the Hf silicate film formed on the substrate in the range of from 0.1 to 1.0, by changing a supply flow rate of the sources (claim 19 further depends on claim

18)

***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to SEAHVOSH J. NIKMANESH whose telephone number is (571)270-1805. The examiner can normally be reached on Mon through Fri 7:30 - 5:00 E.S.T..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Charles Garber can be reached on 571-272-2194. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Seahvosh J Nikmanesh/  
Examiner, Art Unit 2812

/Alexander G. Ghyka/  
Primary Examiner, Art Unit 2812

